CLAIMS

We claim:

1. In a receiver of a multiple-input multiple-output (MIMO) system, a method comprising:

(a) receiving signals from a plurality of transmitter antennas;

(b) for each of a plurality of channels originating from the transmit antennas, estimating a CIR value characterizing impulse response of the channel;

(c) summing the CIR values for the plurality of channels;

(d) integrating the summed CIR values over a specified window;

(e) determining symbol timing in the received signals based on the integrated summed CIR values; and

(f) processing the received signals based on the determined symbol timing.

2. The invention of claim 1, wherein the MIMO system is a MIMO OFDM system.

3. The invention of claim 1, wherein each CIR value corresponds to power of the CIR.

4. The invention of claim 3, wherein each CIR value is based on a correlation between a corresponding received signal and a known training sequence.

5. The invention of claim 1, wherein the specified window has a duration substantially equal to the length of a guard interval of symbols in the received signals.

6. The invention of claim 1, wherein the specified window has a duration substantially equal to a maximum tolerable delay spread for the received signals.

7. The invention of claim 1, wherein the determined symbol timing is based on a maximum for the integrated summed CIR values.

8. The invention of claim 1, wherein the processing of the received signals includes generating a discrete Fourier transform (DFT) for each received signal, wherein timing of the DFT is based on the determined symbol timing.

9. The invention of claim 1, wherein the plurality of channels corresponds to a single antenna of the receiver.

10. The invention of claim 9, wherein a different symbol timing is determined for each different receiver antenna.

11. The invention of claim 10, wherein:

timing of the processing of the received signals for each different receiver antenna is based on the maximum symbol timing for all of the receiver antennas; and

at least one received signal is delayed based on a timing difference between the maximum symbol timing and the symbol timing determined for said at least one received signal.

12. The invention of claim 1, wherein the plurality of channels corresponds to all of the antennas of the receiver.

13. The invention of claim 12, wherein a single, joint symbol timing is determined for all of the receiver antennas.

14. The invention of claim 1, wherein the determined symbol timing corresponds to minimal CIR power falling outside of the specified window and maximal CIR power falling inside the specified window.

15. A receiver for a multiple-input multiple-output (MIMO) system, the receiver comprising:

a plurality of receiver antennas, each adapted to receive signals from a plurality of transmitter antennas in the MIMO system;

a receiver branch for each different receiver antenna, each receiver branch having a transform adapted to transform a corresponding received signal into a plurality of transformed components;

a symbol decoder adapted to receive transformed components from each transform and to detect symbols, wherein:

processing within each receiver branch is based on symbol timing determined for each receiver branch; and

at least one receiver branch is adapted to determine its symbol timing by

(a) for each of a plurality of channels originating from the transmit antennas, estimating a CIR value characterizing impulse response of the channel;

(b) summing the CIR values for the plurality of channels;

(c) integrating the summed CIR values over a specified window; and

(d) determining the symbol timing in the received signals based on the integrated summed CIR values.

16. The invention of claim 15, wherein each CIR value corresponds to power of the CIR, wherein each CIR value is based on a correlation between a corresponding received signal and a known training sequence.

17. The invention of claim 15, wherein the specified window has a duration substantially equal to the length of a guard interval of symbols in the received signals.

18. The invention of claim 15, wherein the specified window has a duration substantially equal to a maximum tolerable delay spread for the received signals.

19. The invention of claim 15, wherein the determined symbol timing is based on a maximum for the integrated summed CIR values.

20. The invention of claim 15, wherein each transform is a discrete Fourier transform (DFT), wherein timing of the DFT is based on the determined symbol timing.

21. The invention of claim 15, wherein the plurality of channels corresponds to a single antenna of the receiver.

22. The invention of claim 21, wherein a different symbol timing is determined for each different receiver antenna.

23. The invention of claim 22, wherein:

timing of the processing of the received signals for each different receiver antenna is based on the maximum symbol timing for all of the receiver antennas; and

at least one received signal is delayed based on a timing difference between the maximum symbol timing and the symbol timing determined for said at least one received signal.

24. The invention of claim 15, wherein a single, joint symbol timing is determined for all of the antennas of the receiver.

25. The invention of claim 15, wherein the determined symbol timing corresponds to minimal CIR power falling outside of the specified window and maximal CIR power falling inside the specified window.

26. A machine-readable medium, having encoded thereon program code, wherein, when the program code is executed by a machine, the machine implements in a receiver of a multiple-input multiple-output (MIMO) system, a method comprising:

(a) receiving signals from a plurality of transmitter antennas;

(b) for each of a plurality of channels originating from the transmit antennas, estimating a CIR value characterizing impulse response of the channel;

(c) summing the CIR values for the plurality of channels;

(d) integrating the summed CIR values over a specified window;

(e) determining symbol timing in the received signals based on the integrated summed CIR values; and

(f) processing the received signals based on the determined symbol timing.